DOCUMENT RESUME

ED 140 275 CS 003 514

AUTHOR McCabe, Patrick P.
TITLE The Effect upon Comprehension of Mathematics Material Repatterned on the Basis of Oral Language.
PUB DATE May 77
NOTE 21p.; Paper presented at the Annual Meeting of the International Reading Association (22nd, Miami Beach, Florida, May 2-6, 1977)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Content Reading; Elementary Secondary Education; *Language Patterns; *Mathematics Materials; Oral English; *Reading Comprehension; Reading Instruction; *Reading Research

ABSTRACT

This study examines the effect upon comprehension, as measured by cloze scores, of material in mathematics that is rewritten on the basis of elementary and junior high school subjects' oral language patterns. Syntactic structures were identified which appeared to inhibit or facilitate comprehension for the subjects involved. The mean number of occurrences of each of certain linguistic structures was calculated and was used as a basis of rewriting a representative passage. The passage was then given to the second of two matched groups. Analyses of results suggest that rewriting material had greater effects on the comprehension of the expository portion than of the narrative portion of the passage. Implications for the classroom teacher, regarding the communicaton process in this technical content area, are discussed. (Author/MB)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

U S DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

ED140275

THE EFFECT UPON COMPREHENSION OF MATHEMATICS MATERIAL REPATTERNED ON THE BASIS OF ORAL LANGUAGE

PERMISSION TO REPRODUCE THIS COPYRIGHTED MATERIAL HAS BEEN GRANTED BY

Patrick P. McCabe

TO ERIC AND ORGANIZATIONS OPERATING UNDER AGREEMENTS WITH THE NATIONAL INSTITUTE OF EDUCATION. FURTHER REPRODUCTION OUTSIDE THE ERIC SYSTEM REQUIRES PERMISSION OF THE COPYRIGHT OWNER

Patrick P. McCabe
Hofstra University
Reading Department
53 I.U. Willets Road
Old Westbury, New York
11580

Presented to the annual meeting of the International Reading Association held in Miami Beach, Florida, May 2-5, 1977.

CS 003 514

THE EFFECT UPON COMPREHENSION OF MATHEMATICS MATERIAL REPATTERNED ON THE BASIS OF ORAL LANGUAGE

This investigation had three major purposes: (1) to examine the effect upon comprehension, as measured by cloze scores, of material in mathematics rewritten on the basis of subjects' oral language patterns, (2) to examine the effect of repatterning expository material compared to repatterning narrative material which appears in a mathematics context, and(3) to determine, more specifically, those linguistic structures which appear to facilitate or interfere with communication.

Related Literature

Repatterning

Ruddell(1963) noted that comprehension scores were significantly higher for passages which approximated the syntax of subjects compared to passages which did not reflect the oral language pattern of the subjects. Amsden(1964) indicated that researchers concerned with the teaching of reading should pay closer attention to the oral language of their subjects. This investigator conducted a study which indicated a greater degree of comprehension with text controlled to approximate subjects' oral discourse. Williams(1968) observed that rewritten science text material resulted in a greater increase in comprehension for poor readers than good readers. More specifically, it was not merely the simplification of syntax which resulted in greater increase in comprehension; but rather, the precise matching of the syntax of the reader with the syntax of the author of the text which appeared to enhance communication. Smith

(1970), working with 120 subjects of different developmental levels, concluded that the level of production was the best level of reception for the subjects in his study. Tatham(1970) rewrote material on the basis of oral language and found that children in grades two and four scored significantly higher on material rewritten on the basis of their own oral language patterns compared to that of the text. Fagan(1971) found that reading comprehension appeared to depend upon the type of syntactic structure of the printed language. Finally, Peltz(1973) rewrote secondary social studies material on the basis of subjects' written discourse and found a significant difference in comprehension when cloze was the measure of comprehension.

Cloze Procedure

The cloze procedure has been used in many studies as the dependent measure. Ruddell(1963) and Rankin and Dale(1963) used the cloze procedure as a measure of comprehension of textual and/or rewritten material. Also, Kane and Hater(1972) used the cloze procedure to determine the difficulty of mathematics passages.

Hypotheses

Two substantive and one null hypotheses, growing from the literature, were tested across three conditions yielding a total of nine hypotheses. Condition one examined the passage as a whole, condition two examined the first half of the passage, and condition three examined the second half of the passage. (There appeared to

be a difference in the style of writing within the passage itself, therefore the two latter conditions were examined. Approximately one-third of the first half of the passage was narrative in style describing the situation of a girl about to enter high school who was, as a result, going to receive twice her previous allowance. Also contained, in this portion of the passage, were general, introductory statements about using algebra to solve problems. The second half of the passage explained, in detail, how to actually solve algebra problems in a step by step manner. The second half, in contrast to the first half, was expository in nature.)

Based on the above rationale, the following hypotheses were tested across the three conditions:

(1) Discourse presented in syntax which approximates the syntax of subjects will result in significantly higher cloze scores(at the .05 level) than discourse presented in the syntax of the text.

(2) Subjects considered "good" in mathematics will score significantly higher on cloze passages(at the .05 level) than subjects considered "poor" in mathematics.

(3) There will be no significant interaction between the main effects of student ability and language form presented at the .05 level.

Research Design and Procedure

Subjects in the present investigation were 152 randomly selected ninth graders at a junior high school located on Long Island, New York. Students scoring at or over two-thirds of a standard

deviation from the mean on the New York State Pupil Evaluation Program(PEP)Test in Mathematics, administered in October, 1974, were designated "good" and "poor" ability students in mathematics. All students scoring below minimum competency(fifteenth percentile) on the New York State PEP Test in Reading were eliminated from the sample pool prior to the "good" and "poor" determination.

The study was conducted in three phases over the five month period from January to May, 1975. Phase one consisted of the administration of a cloze passage, constructed across the textbook material to a group of seventy-six subjects chosen by selecting every alternate subject from the total(152) eligible for consideration in this study. The particular passage was selected based on (1) pilot work and (2) the fact that it was an expository passage, for the most part, which "explained" how to use algebra to solve word problems.

Phase two consisted of individually interviewing thirty subjects randomly selected from the total of thirty-seven who scored at, or above, fifty-seven percent on the phase one cloze test. Each subject was asked to pretend that the investigator was a ninth grader who was experiencing difficulty in algebra. The subjects' task was to try to explain a selection taken from a ninth grade mathematics textbook so that this "pseudo ninth-grader" (the investigator) would be able to understand algebra. (The passage was the same one given to the subjects six weeks earlier in cloze format.) Subjects were asked to retell, in their own words,

every few sentences of the selection. The subjects were allowed to refer to the passage when they forgot or did not understand what they read but were discouraged from giving verbatim responses. In this manner, the entire passage was "retold." All responses were taped, transcribed, and analyzed according to a linguistic analysis worksheet dealing, to a large degree, with noun replacement and noun expansion transformations.* In a noun replacement transformation, a clause replaces and takes the function of a noun. For example, "His remark was not what they needed..." would become, "What he said was not what they needed..." Noun expansion transformations are generally achieved by inserting relative words or clauses. An example of this would be "The boy, who was fat, ran down the street" or "The fat boy ran down the street." Forty-one transformations were counted which fit into the following three general categories. The first group consisted of simple transformations, such as simple sentences; the second group consisted of embedded transformations of which noun replacement and expansion transformations are examples; and the third group consisted of conjoining transformations which included "connectives" like "and," "also," and "then."

Mean occurence of each of these structures per t-unit was calculated across the subjects. A t-unit is an independent clause and any subordinate clauses attached to it(Hunt, 1965). The mean number of each of these structures was then used to construct a

*Adapted from a Linguistic Analysis Worksheet developed by Fillmore Peltz in a doctoral dissertation at Hofstra University, 1973. (See Appendix.)

passage representative of the subjects' language patterns. In other words, the mean number of each structure was the formula followed in rewriting the passage. For example, if the subjects employed adverbial clauses of time a mean number of 9.07 times across all their retold passages, then care was taken to use nine of these particular constructions in the representative passage constructed by the investigator. If the subjects used the infinitive as object a mean number of 3.7 times across all their retold passages, then care was taken, in constructing the repatterned passage, to utilize this particular construction four times. This was the procedure followed for each of the structures counted.

In phase three, sixty-eight subjects(the subjects remaining after the phase one selection procedure) were given the representative passage in cloze format with every fifth word deleted across a total of 514 words. In order to have a completely counterbalanced design, the two passages(the original and the repatterned) were divided into two approximately equal halves and the complementary portion of both the repatterned and the original passages were matched and presented to the subjects. In other words, all subjects in this phase received either form RO(repatterned first half, original second half) or form OR(original first half, repatterned second half). After a check for homogeneity of variance, three analyses of variance with weighted means were employed to examine the data.

Findings

The findings will be reported in terms of the three purposes of this investigation. The first purpose was to determine the effect upon comprehension of repatterning textual material based on oral language patterns across the passage as a whole, ignoring the style of the language. Table one(below) presents the findings of this analysis.

Table 1 Analysis of Variance of Cloze Scores on Original and Repatterned Language

Source	SS	df	MS	F
Ability	4669.79	1	4669.79	38.12**
Language	2718.77	1	2718.77	22.20**
Interaction	126.68	1	126.68	1.03
Error	16618.57	132	122.49	

$F_{95(1,132)}=3.92$ ** $p<.01$

The results of comparing the textual language(original first and second halves combined) and the repatterned language (repatterned first and second halves combined) indicated that both language form and student ability contributed significantly to total variance, with the exact probability of occurence under .01. These results were consistent with the predictions of

hypotheses one and two. In addition, the lack of significant interaction was consistent with the null hypothesis.

The second purpose was to examine the effect upon comprehension of repatterning expository compared to narrative styles of presentation. The results of this comparison are presented in tables two and three(below).

Table 2 Analysis of Variance of Cloze Scores on the Original and Repatterned First Half

Source	SS	df	MS	F
Ability	906.34	1	906.34	17.51**
Language	152.71	1	152.71	2.95
Interaction	61.63	1	61.63	1.19
Error	3416.74	66	51.77	

$F_{95}(1,66)=4.00$ $^{**}p < .01$

Table two indicates that student ability was a significant main effect when the first half of the passage was under consideration. However, language was found to be a non-significant main effect contrary to the prediction of hypothesis one. Finally, the null hypothesis was accepted in this analysis.

The following table shows a comparison between the original and the repatterned second half which was the expository section of the passage.

Table 3 Analysis of Variance of Cloze Scores on Original and Repatterned Second Half

Source	SS	df	MS	F
Ability	5365.39	1	5365.39	43.51**
Language	3535.37	1	3535.37	28.67**
Interaction	48.49	1	48.49	.39
Error	7891.95	64	123.31	

$F_{95}(1,66)=4.00$ $^{**}p < .01$

Table three indicates that student ability and language form were both significant main effects, with the exact probability of occurence less than .01. The interaction was non-significant. All three of these results were predicted by the hypotheses.

In terms of the third purpose of this investigation, a specific comparison between the syntax of the text and that of the subjects was performed. Forty-one surface structures were counted for the textual and the representative passages; however, just those structures which differed significantly between the two passages will be presented below(see table four). The following represents the results of this analysis.

Table 4 Specific Comparison of Linguistic Structures Between Original and Repatterned Passages

Structure	Mean Number of Times Used	
	O	R *
1. "It-Verb-Subject" (It is an easy problem.)	6.00	11.13
2. "Wh+Sentence as Object" (The equation states what is said in the paragraph.)	0.00	3.40
3. "Infinitive as Object" (You should try to reread the problem.)	7.00	12.27
4. "Additive Conjunction between Independent Clauses" (...and...and...)	4.00	12.46
5. "Conjunctions between Dependent Clauses"		
(a) so...	0.00	5.67
(b) then...	1.00	4.83
6. "Nominative-Direct Object Passive Verb" (The allowance was doubled by Paula's father.)	14.00	8.17
7. "That+Sentence as Object" (The problem states that the allowance was doubled.)	9.00	3.70
8. "Genitive Phrases"	14.00	4.27
9. Adjectives	17.00	9.00

*O=Original(Text) Passage
R=Repatterned Passage

As can be seen in the above table, the subjects used constructions one through five to a significantly greater degree in their oral language compared to the language of the text. On the other hand, the author of the text used constructions six to nine to a significantly greater degree than the subjects did in their oral retelling of the passage.

A final comparison between the t-units of the text compared to the t-units of the repatterned passage indicated that subjects used less words per t-unit than the author of the text. (See table five.)

Table 5 Number of Words and T-units per Passage

Passage	t-units	words	words/t-unit
Original(Text)	35	513	14.65
Repatterned	43	514	11.95

Discussion

The results indicated that material presented to the subjects was understood best when the language patterns employed approximated the syntax of the subjects when expository material was presented. When narrative material was presented, however, it appeared that subjects were able to comprehend either syntactic pattern. As could be expected, "good" ability subjects scored better than "poor" ability subjects, ignoring form of language.

The lack of significant interaction suggested the use of the repatterned expository material for all subjects.

In addition, certain surface structures were isolated which appeared to interfere with or facilitate communication between the sender(author) and the receiver(reader) of the particular message. Also, the subjects appeared to use less words per t-unit than the author of the text. In other words, the text appeared to squeeze more words(concepts) into each t-unit. The subjects in this investigation, however, tended to use more t-units to express themselves. In terms of information processing models of communication, the textual presentation may have "overloaded" the communication channel of the reader.

Conclusions and Implications

It is suggested here that the difference in syntactic pattern between the two passages contributed to the difference in comprehension. Passives, noun replacement transformations of the form "that+sentence as object," and genitive constructions were rarely used by the subjects, but were present in the textual passage to a significantly greater degree. For example, sentences such as "The allowance was doubled by her father" or "The problem states that the allowance is now sixteen dollars" represent the first two constructions and when these were included, the passage did not appear to be understood as well as when these constructions were not included.

The greater use of the "infinitive as object," "wh+sentence as object," and the extensive use of conjoining constructions between independent clauses appeared to facilitate comprehension in the repatterned passage. For example, constructions such as "You should try to solve the problem," "The equation represents what Paula's allowance is now," and conjoining words like "and," "so," and "then" were present in the subjects' discourse to a large degree. These latter conjoining constructions appeared to link concepts for these subjects. Ideas appeared to be joined through the use of the connective words noted above. In fact, even though such connectives might never appear in a text between independent clauses due to certain conventions of writing("avoid 'run-on' sentences"), it might be better to include them, to a greater degree, for the sake of students comprehension(above the protests of editors).

It should be noted that it was not merely the presence of embeddings which effected comprehension, but rather the type of embedding employed. For example, two types of embedding which appear to be similar are the "that+sentence as object" and the "wh+sentence as object" constructions. However, on the basis of the present investigation, the latter appeared to have a facilitative effect upon understanding.

It is also important to note that it did not matter which syntax was used when narrative material was presented; however, when expository material was presented, syntax appeared to have

a greater effect upon comprehension. This makes sense if an inverse relationship between syntax and semantic familiarity is hypothesized. This means that when material presented is familiar or, at least, relevant to students' experiential background, unfamiliar syntax will be compensated for by the semantic relevance of the passage. When semantic input is unfamiliar or not as relevant to students' experiential background, language structure becomes more important. It is suggested here that, in the latter situation, students appear to look for a familiar framework or structure upon which to begin to make sense of, or organize, the information on the page.

In other words, "story telling" could, on the basis of the results of this investigation, be presented with less regard to syntax than when "explaining" concepts to students. In the latter case, the use of the students' own language form would probably be the most efficient mode of communication.

Teachers of mathematics and teachers of reading concerned with the reading of mathematics should become sensitive to those structures used by their students in their natural discourse. This means that teachers should first become good listeners and then try to include, in their own oral or written exposition, as many of those linguistic structures employed by their students as possible. As a corollary, the use of linguistic structures which students do not use should be minimized.

In the study reported here, specific constructions were isolated, however, these may vary from class to class and across developmental levels. This means that teachers should be willing and able to "adjust" their syntax to meet the needs of the particular group of students they might be working with. This will probably facilitate the learning of new concepts with a minimum of interference.

References

Amsden, Constance. "Oral Language and Printed Word Reading," in Malcolm P. Douglass(ed.), The Claremont College Reading Conference Yearbook. Claremont, California: Claremont Graduate School, 1964, 90-94.

Fagan, William T. "Transformations and Comprehension," Reading Teacher, XXV(November, 1971), 169-72.

Hunt, Kellogg W. Grammatical Structures Written at Three Grade Levels. Champaign, Illinois: National Council of Teachers of English, 1965.

Kane, Robert B. and Hater, Sister Mary Ann. "The Cloze Procedure as a Measure of Reading Difficulty of Mathematical English Passages." Office of Education(DHEW), Bureau of Research, August, 1972, Washington, D.C.(ERIC No. 071-057)

Peltz, Fillmore K. "The Effect Upon Comprehension of Repatterning Material Based on Students' Writing Patterns," Reading Research Quarterly, IX(1973-74), 613-33.

Rankin, Earl F. and Dale, Lothar A. "Cloze Residual Gain--Technique of Measuring Learning Through Reading," Eighteenth Yearbook of the National Reading Conference, Milwaukee, Wisconsin: National Reading Conference, 1969, 17-26.

Ruddell, Robert B. "An Investigation of the Effect of the Similarity of Oral and Written Patterns of Language Structure on Reading Comprehension," Unpublished Doctoral Dissertation, Indiana University, 1963.

Smith, William L. "The Effect of Transformed Syntactic Structures on Reading," in Carl Braun(ed.), Language, Reading and the Communication Process. Newark, Delaware: International Reading Association, 1970, 52-62.

Tatham, Susan. "Reading Comprehension of Material Written with Select Language Patterns: A Study at Grades Two and Four," Reading Research Quarterly, V(Spring, 1970), 402-06.

Williams, D.L. "Rewritten Science Materials and Reading Comprehension," Journal of Educational Research, LXI(Jan., 1968), 204-06.

LINGUISTIC ANALYSIS WORKSHEET*

Student_____ T-unit number_____

1._____mean number of words per t-unit

SIMPLE TRANSFORMATIONS	EXAMPLE
2._____There-Verb-Subject	There was a girl named Paula.
3._____It-Verb-Subject	It is an easy problem
4._____Nominative-Direct Object-Verb Passive	The allowance was doubled
5._____Nominative-Indirect Object-Verb Passive	Paula was given an allowance
6._____Question	What was her allowance before she entered high school?
7._____Negation	Paula did not have enough money.
8._____Negation-shift	
EMBEDDING TRANSFORMATIONS	
9._____That+Sentence as Subject	That her allowance was increased gladdened Paula,
10._____That+Sentence as Object	The problem states that the allowance was doubled
11._____(That)+Sentence as Object	We know(that) the answer is right.
12._____Wh+Sentence as Subject	What the allowance was before it was doubled is not told to you
13._____Wh+Sentence as Object	The equation states what is said in the paragraph
14._____Wh+ever as Subject	Whatever is done to one side is done to the other.

15. _____ Wh+Ever as Object — You should replace <u>whatever they dont say</u>.

16. _____ Infinitive as Subject — <u>To solve the problem</u> is easy.

17. _____ Infinitive as Object — You should try <u>to reread the problem</u>...

18. _____ Gerundive as Subject — <u>Paula's spending</u> caused her father to increase the allowance.

19. _____ Gerundive as Object — Paula reviewed <u>her spending</u>.

B. Noun Expansion
(1) Relative Clauses

20. _____ Relative Clause(Be) — <u>who is a student</u>

21. _____ Relative Clause(Have) — <u>which had no specified amount</u>

22. _____ Relative Clause(Verb) — <u>who increased the allowance</u>

23. _____ Adverbial Clause(Time) — <u>before she entered high school</u>

24. _____ Adverbial Clause(Place) — <u>where the X is</u>

25. _____ Adverbial Clause(Manner) — <u>how you can solve</u>

26. _____ Adverbial Clause(Motive) — <u>why we check it</u>

(2) Post Noun Relative Phrases
(Derived in reduction of relative clauses)

27. _____ Prepositional Phrases — (who was) <u>in high school</u>

28. _____ Genitive Phrase — (which are) <u>of the problems</u>

29. _____ Participial Phrase — (which is) <u>multiplied by x</u>

30. _____ Infinitive — (who is) <u>to solve</u>

31. _____ Infinitive Phrase — (who is) <u>to enter high school</u>

32._____Appositive Phrase — Paula,(who is) a high school freshman

(3) Relative Words

33._____Adjective — weekly allowance

34._____Participle — increased allowance

35._____ Possessive — her allowance

CONJOINING TRANSFORMATIONS

A. Conjunctions joining independent clauses

36._____Additive — and

37._____Adversative — but

B. Conjunctions joining dependent clauses

38._____Causal — because

39._____Conditional — if

40._____ — so

41._____ — then

*This worksheet was adapted from Peltz' worksheet